Technical Report No. AF-105

WAVE FUNCTIONS, ENERGIES, AND REDUCED MATRIX ELEMENTS OF THE $5f^3$ CONFIGURATION IN INTERMEDIATE COUPLING

by

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THE JOHNS HOPKINS UNIVERSITY
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BALTIMORE, MD.

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ERRATA - AF 104 - A Forming Study of Point-Contact Tunnel Diodes - H. J. Lory - May 1963

Page 11 line 9 reads aresnic - should be arsenic

Page 20 line 12 reads normal of N- should be - normal or N-

Page 35 equation (8) should be $\sqrt{2}$ $2\hbar\varepsilon$ e in the denominator

Page 88 line 14 reads H on D_o, should read H or D_o.

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ABSTRACT

Since the crystal field can be considered as a perturbation of the free ion spectra of actinide ions in certain crystals, we have calculated energy levels and wave functions of the $5f^3$ configuration, which is the ground configuration of U^{3+}, in intermediate coupling for values of $\chi = \zeta/F_2$ of 7 to 11. Energy levels are given in units of F_2, and wave functions are expressed as linear combinations of Russell-Saunders functions. Hydrogenic and non-hydrogenic approximations are compared.

Reduced matrix elements in intermediate coupling are given so that crystal field splittings may be calculated. The splittings of the two lowest levels of U^{3+} in a weak field with and without J-mixing are compared.

I. INTRODUCTION

In the triply ionized actinides the optically active electrons belong to the $5f^n$ configuration[1,2], so comparison of their spectra with those of the triply ionized rare earths, whose optically active electrons belong to the $4f^n$ configurations, is of considerable interest. The effect of the crystal field on rare earth ions is small enough to be treated as a perturbation of the free ion spectra; this is also true for the actinide ions, at least in some crystals[3-9]. In a free ion, electric dipole transitions within a configuration are forbidden, but the odd parity part of the crystal potential will mix configurations of opposite parity so that "forced" electric dipole transitions can take place as well as the allowed magnetic dipole transitions. The strength of the forced electric dipole transition depends inversely upon the energy differences between mixing configurations[10,11]. In crystals containing triply ionized actinides total absorption begins at about 4000A, and it is assumed that this is due to the allowed 5f-6d transitions. (Knowledge of the free ion spectra would be useful here). Since the analogous 4f-5d transitions in rare earth crystals take place at about 2000 A[12], more intense spectra can be expected from this effect in actinide crystals than in rare earth crystals.

The ground configuration of U^{3+} is $5f^3$. Since nothing is known experimentally about the free ion spectrum of U^{3+}, we have made calculations on the $5f^3$ configuration to aid in the interpretation of crystal spectra.

II. FREE ION

The Hamiltonian for the free ion is

$$H_f = H_o + H_e + H_s \quad ,$$

where H_o is the interaction of the 5f electrons with the core (constant for the configuration)

H_e is the electrostatic interaction between the three 5f electrons

H_s is the spin orbit interaction.

Higher order effects, including spin-spin and spin-other-orbit interactions will be neglected.

The electrostatic interaction is

$$H_e = \sum_{i>j} \frac{e^2}{r_{ij}} \quad i, j = 1, 2, 3 \quad ,$$

where electrons in closed shells are assumed to affect the energies of the 5f electrons only by a contribution to the central potential. We can expand $\frac{1}{r_{ij}}$ in terms of the Legendre polynomials[13]

$$\frac{1}{r_{ij}} = \sum_{k=0}^{\infty} \frac{r_a^n}{r_b^n} P_n(\cos \omega) \quad ,$$

where r_a is the smaller and r_b the larger of the distances of r_i and r_j from the nucleus, and ω is the angle between r_i and r_j. Then we can separate the radial and angular components and write

$$H_e = \sum_n f^n F_n \quad n = 2, 4, 6 \quad \text{for f electrons} \quad .$$

Matrix elements of f^n are essentially integrals of spherical harmonics over the angular wave function, and have been evaluated by Carlson[14] for f^3 using Racah's method. The F_n are integrals of $\frac{r_a^n}{r_b^{n+1}}$ over the 5f radial wave functions (Slater integrals). If 5f hydrogenic wave functions are assumed, that is, in a Coulomb field, Judd[15] has calculated

$$F_4/F_2 = 0.1422 \quad \text{and} \quad F_6/F_2 = 0.0161 \quad .$$

The spin orbit interaction is

$$H_s = \sum_{i=1}^{3} \xi(r_i)\, \vec{\ell}_i \cdot \vec{s}_i \quad .$$

ζ, the integral of $\xi(r_i)$ over the radial wave function, is determined experimentally due to lack of knowledge of the wave function. The matrix elements of the angular part of H_s have been calculated for f^3 by Judd and Loudon[16]. In U^{3+} the spin orbit interaction is rather large, therefore we had to perform intermediate coupling calculations. Since J is a good quantum number, this involved diagonalizing matrices for each J value, 1/2 to 17/2. The electrostatic matrices, assuming 5f hydrogenic wave functions, and spin orbit matrices have been diagonalized simultaneously, by using a program developed

by Wybourne*, for various values of $\chi = \zeta/F_2$ expressing energies in terms of F_2 and wave functions as linear combinations of Russell-Saunders states. Figure 1 shows the variation in energy levels of f^3 with χ, for χ = 7 to 11. The levels are named by the Russell-Saunders states into which they go at $\zeta = 0$. For $F_2 = 200$, $\chi = 8$, (the order of magnitude appropriate for U^{3+})[17], it is noted that the configuration extends 35,000 cm^{-1}. In comparison, the Nd^{3+} $4f^3$ configuration extends 67,000 cm^{-1}. The 41 levels are each (2J + 1)-fold degenerate.

The use of the 5f hydrogenic wave functions for U^{3+} is questionable. Lammermann and Conway[8] feel that the Coulomb approximation is satisfactory for the interpretation of the $Pu^{3+}(5f^5)$ spectrum. Cohen has done a relativistic self-consistent calculation for the normal uranium ion, and Winocur has calculated the following set of Slater integrals from Cohen's eigenfunctions[18]

$$F_4/F_2 = 0.159 \qquad\qquad F_6/F_2 = 0.0204.$$

The discrepancy between a similar calculation for PrIV and the experimental values indicates that these should be treated with reserve[17].

McLaughlin[9] determined F_2, F_4, and F_6 experimentally by a least squares fit to the spectrum of $UCl_4(5f^2)$ and found the ratios to be

* Private communication.

$$F_4/F_2 = 0.1468 \qquad F_6/F_2 = 0.0219 \quad .$$

We have calculated energy levels and wave functions of f^3 using these last ratios with $\chi = 8.0$, and the energy levels are compared with hydrogenic ones in Figure 2. F_2 has been chosen to put the $^4I_{11/2}$ level at 4500 cm^{-1} from the ground state where it has been observed[19, 20]. It is apparent that the position of the $^4F_{3/2}$ level relative to the $^4I_{13/2}$ is depressed in the non-hydrogenic case, and above 10, 000 cm^{-1}, where the energy levels become more dense, the grouping is much different in the two cases.

III. CRYSTAL FIELD

We are interested in crystals in which the splitting of the J manifold is small compared to the spin-orbit splitting, so in a first approximation the crystal field interaction can be treated as a perturbation of the free ion energy levels. However, since the 5f wave functions are more extensive than the 4f wave functions[22], somewhat larger crystal field effects can be expected in the actinides than in the rare earths. Each J level of an ion with an odd number of electrons will split in a crystal field into $(2J + 1)/2$ components at the most due to Kramers degeneracy.

The Hamiltonian for the crystal field interaction, assuming a purely electrostatic field is[23]

$$H_c = \sum_{kq} A_k^q \langle r^k \rangle V_k^q(\theta, \phi) \quad |q| \leq k, k = 2, 4, 6 \text{ for f electrons.}$$

The number of terms in the expansion depends on the symmetry of the ion site in the crystal. The coefficients A_k^q depend on the lattice, and, although it is theoretically possible to calculate them if the positions and charge distributions of the ions in the crystal are known, results have not been satisfactory. Therefore, $A_k^q \langle r^k \rangle$ are customarily treated as experimentally determined parameters. The V_k^q are normalized associate spherical harmonics which transform in the same manner as the unit tensor operators U_k^q and are related to them by constant factors. We may use either set for calculations. Matrix elements of the crystal potential, for LS coupling then, can be obtained by using the relation[15]

$$\langle \alpha\, LSJM | U_q^k | \alpha' L'S'J'M' \rangle = \delta(SS')(-1)^{J-M} \begin{pmatrix} J & k & J' \\ -M & q & M' \end{pmatrix} \langle \alpha\, LSJ \| U^k \| \alpha' L'S'J' \rangle,$$

where the reduced matrix element is

$$\langle \alpha LSJ \| U^k \| \alpha' L'S'J' \rangle = (-1)^{S+k+L'+J} \left[(2J+1)(2J'+1) \right]^{1/2} \begin{Bmatrix} L & J & S \\ J' & L' & k \end{Bmatrix} \langle \alpha LS \| U^k \| \alpha' L'S \rangle .$$

3-j symbols $\begin{pmatrix} J & k & J' \\ -M & q & M' \end{pmatrix}$ and 6-j symbols $\begin{Bmatrix} L & J & S \\ J' & L' & k \end{Bmatrix}$ are vector coupling coefficients and are available in tabular form[24]. Judd has tabulated[25] the double reduced matrix elements $\langle \alpha LS \| U^k \| \alpha' L'S \rangle$ for f^3. If J mixing is neglected, the matrix elements may be more simply calculated from

$$\langle \alpha LSJM | V_k^q | \alpha' L'SJM' \rangle = \langle \alpha\, LSJ \| V_k \| \alpha' L'SJ \rangle\, f_k S_k^q(M),$$

where $S_k^q(M)$ are the Stevens coefficients[26] and the f_k, which depend only on J, are proportionality constants chosen to make the S_k^o integers.

U^{3+} states can be represented by linear combinations of Russell-Saunders states with coefficients depending on χ; therefore the crystal field matrix elements will also depend on χ, and we have obtained them for $\Delta J = 0$ by the same transformation which diagonalized the $5f^3$ energy matrix.

Table I presents the results of calculations we have made on the $5f^3$ configuration using hydrogenic wave functions. For each J value for $\chi = 7.0$ to 11.0, energies in units of F_2 are given in the first row. In the columns below each energy level are the coefficients

of the LS wave functions for that level. Reduced matrix elements in intermediate coupling are given in terms of $\langle \alpha LSJ || V_k || \alpha L'SJ \rangle$ $f_k \times 10^3$ in order that they may be used with the Stevens coefficients given in Table II[26,27]. The last row of each column gives the Landé g-value of the level in intermediate coupling.

As an example of the use of the tables, the splitting of a $^4F_{5/2}$ level in D_{3h} symmetry for $\chi = 8$ is $(-0.00937)\, S_2^0(M) + (-0.02391)\, S_4^0(M)$ or

$$(-0.00937)\times5\times A_2^0+(-0.02391)\times1\times A_4^0=-0.04685A_2^0-0.02391A_4^0,\ m=5/2$$
$$-(0.00937)\times(-1)\times A_2^0-(0.02391)\times(-3)\times A_4^0=0.00937A_2^0+0.07173A_4^0,\ m=3/2$$
$$-(0.00937)\times(-4)\times A_2^0-(0.02391)\times2\ A_4^0=0.03748\,A_2^0\ -0.04782\ A_4^0,\ m=1/2\ .$$

In a crystal field J is only approximately a good quantum number, so that J levels will also be mixed. A complete J mixing calculation would involve diagonalizing three 60- and 61-dimensional matrices, and does not seem to be worthwhile until more is known about the wave functions. However, in order to get an idea of the magnitude involved, J mixing of the $^4I_{9/2}$ and $^4I_{11/2}$ states can be calculated by second order perturbation theory. (For higher levels which become more nearly degenerate this cannot be done).

We have calculated the splittings of the $^4I_{9/2}$ and $^4I_{11/2}$ states using 5f hydrogenic wave functions for $\chi = 8.0$ and the fictitious crystal field parameters

$$A_2^o\langle r^2\rangle = 170 \qquad A_6^o\langle r^6\rangle = -100$$

$$A_4^o\langle r^4\rangle = -80 \qquad A_6^6\langle r^6\rangle = 1100 \quad ,$$

which are close to those found by Gruber[4] for Am^{3+} in $LaCl_3$. The effect of the $^4I_{11/2}$ state on the $^4I_{9/2}$ state 4500 cm^{-1} below it is to depress the ground Stark level by 27 cm^{-1} and to increase slightly the overall splitting. The calculated splittings of the $^4I_{11/2}$ and $^4I_{9/2}$ levels using the above parameters, with and without J mixing, are shown in Figure 3.

CONCLUSION

Experimentally, a complication occurs in uranium doped crystals in that uranium readily ionizes to U^{4+} and less easily to U^{3+} so that crystals nominally containing U^{3+} sometimes contain both ions, as was the case for $CaF_2:U^{3+}$.[28, 29] The ground configuration of U^{4+} is $5f^2$. In Figure 4 we compare McLaughlin's energy level diagram for U^{4+} with our calculated one for $5f^3$ for reasonable values of F_2 and χ, and find that the energy levels are often very close, especially when we take into account Stark splitting, which could spread each level by several hundred cm^{-1}. However, a 1.88μ absorption line, described as characteristic of U^{3+} [28, 29] does not fit into the $5f^3$ energy level scheme. Either hydrogenic wave functions are decidedly in error or this 1.88μ line belongs to U^{4+}, where it could fit into the $^3H_5$ state.

It is difficult to see how these levels can be definitely assigned until the free ion spectra have been analyzed. Also it is quite desirable to know the position of the 6d configuration in order to estimate line strengths. Therefore, a program has been initiated to analyze the free ion spectra of ionized uranium. We hope to start with UIV (U^{3+}) and to go on to UIII and UV. This work will be done in cooperation with the Physics Department of The Johns Hopkins University.

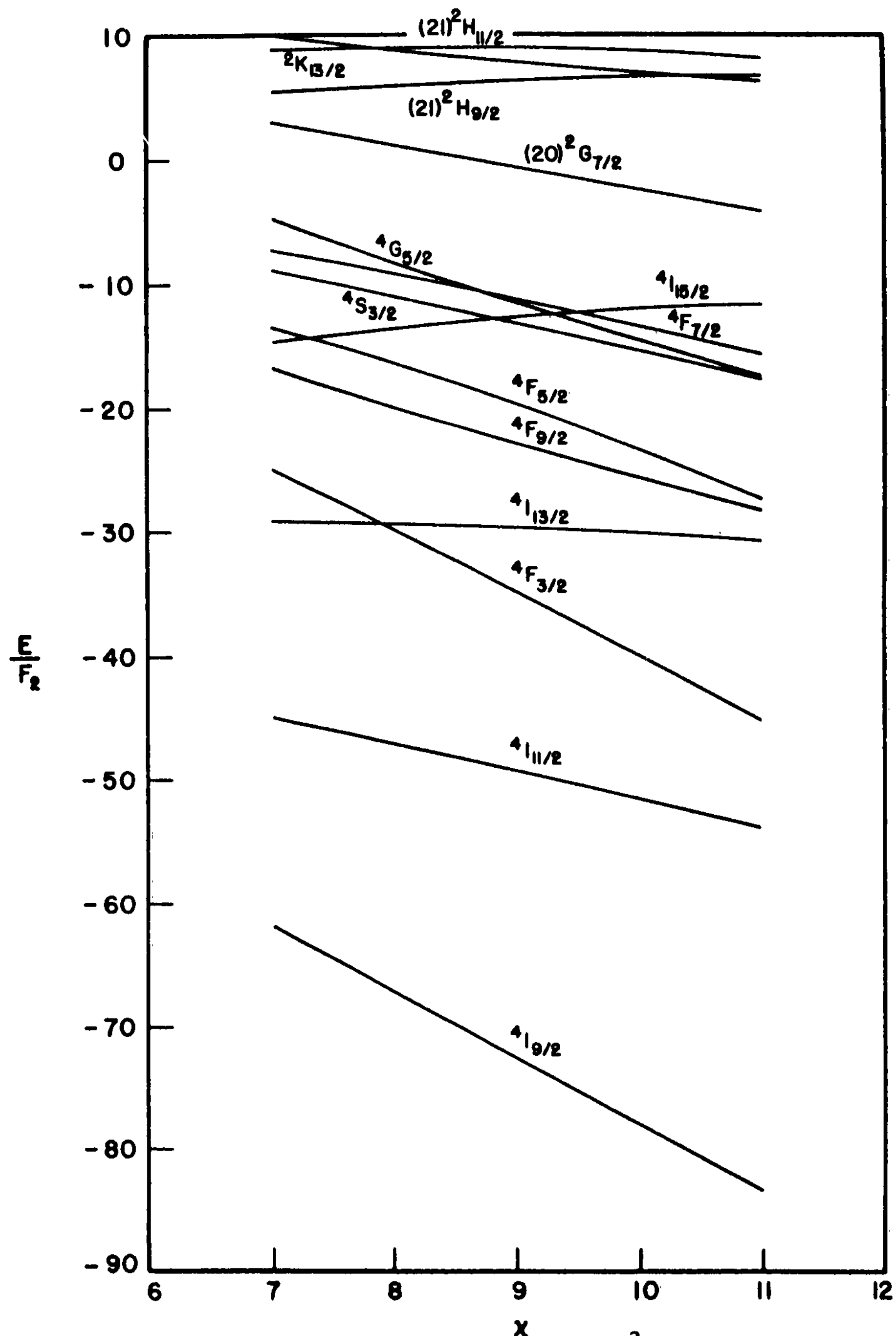

FIGURE 1a ENERGY LEVELS OF THE $5f^3$ CONFIGURATION.

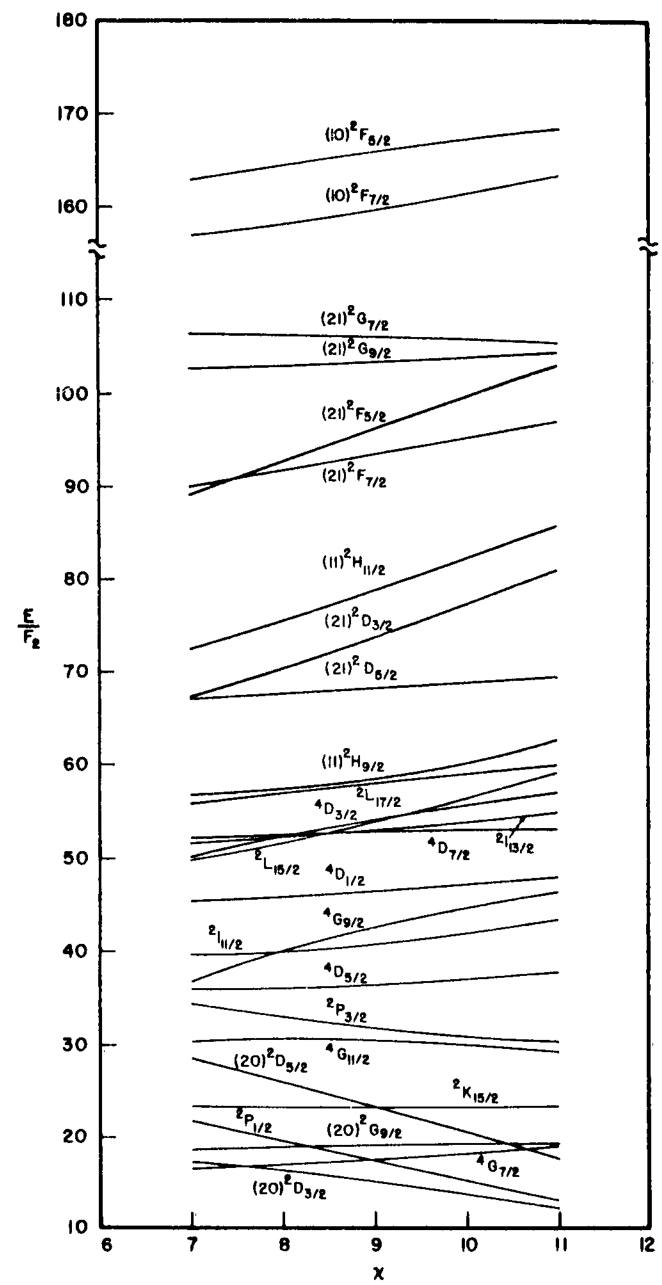

FIGURE 1b ENERGY LEVELS OF THE $5f^3$ CONFIGURATION.

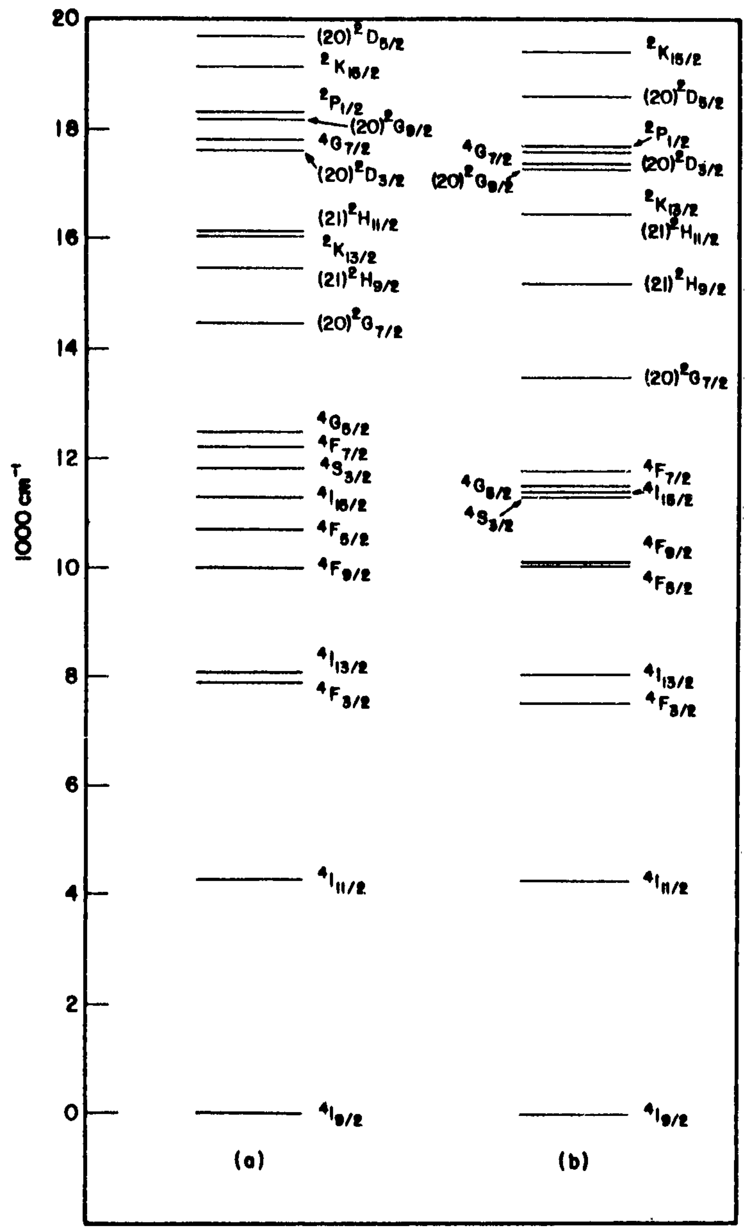

FIGURE 2 LOW-LYING ENERGY LEVELS OF THE $5f^3$ CONFIGURATION FOR $\chi = 8$.

(a) $F_2 = 211$ $F_4 = 30.004$ $F_6 = 3.3971$ (hydrogenic)

(b) $F_2 = 213$ $F_4 = 31.098$ $F_6 = 4.6647$ (McLaughlin's ratios[9] from U^{4+}).

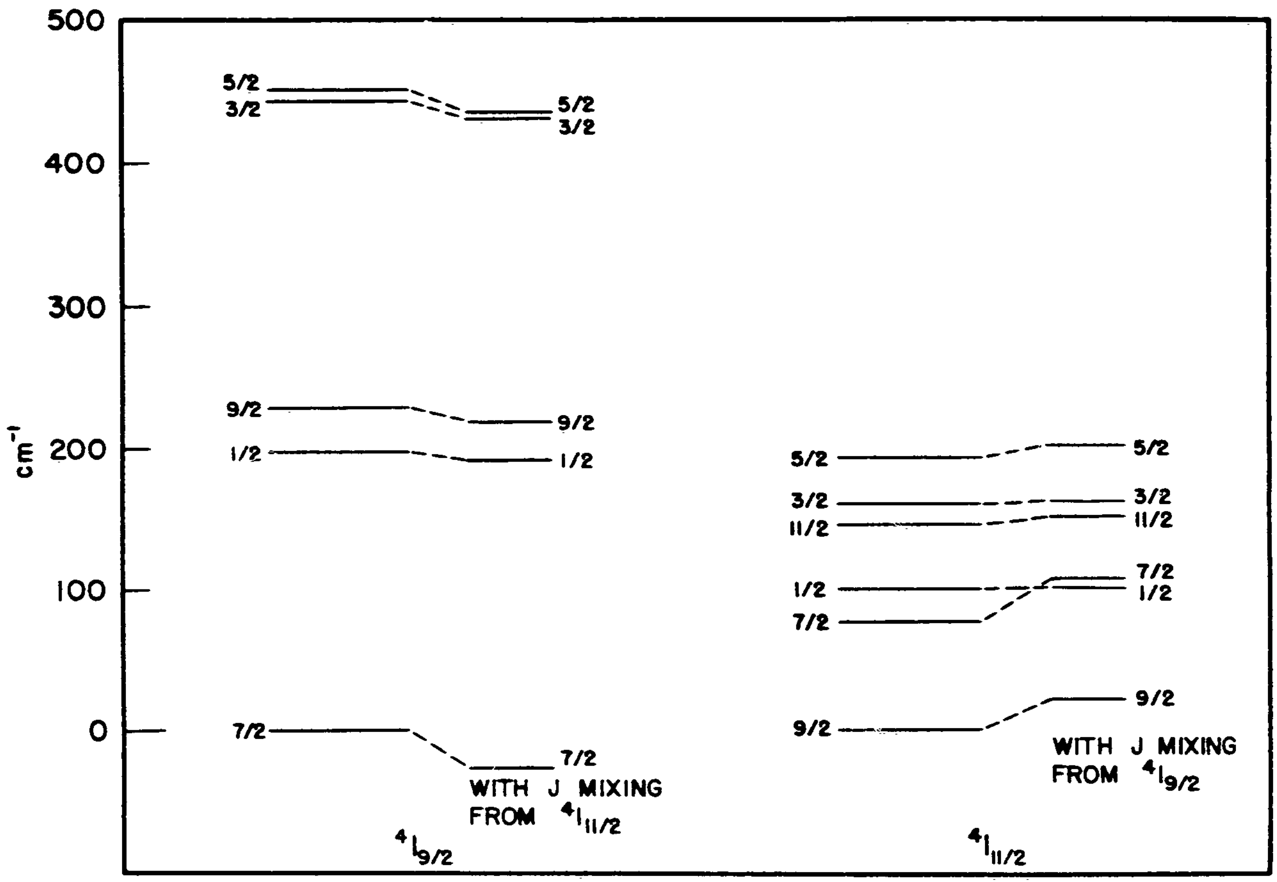

FIGURE 3 CRYSTAL FIELD SPLITTING IN A D_{3h} SYMMETRY SITE

$A_2^0\langle r^2\rangle = 170$ $\qquad$ $A_6^0\langle r^6\rangle = -100$

$A_4^0\langle r^4\rangle = -80$ $\qquad$ $A_6\langle r^6\rangle = 1100$.

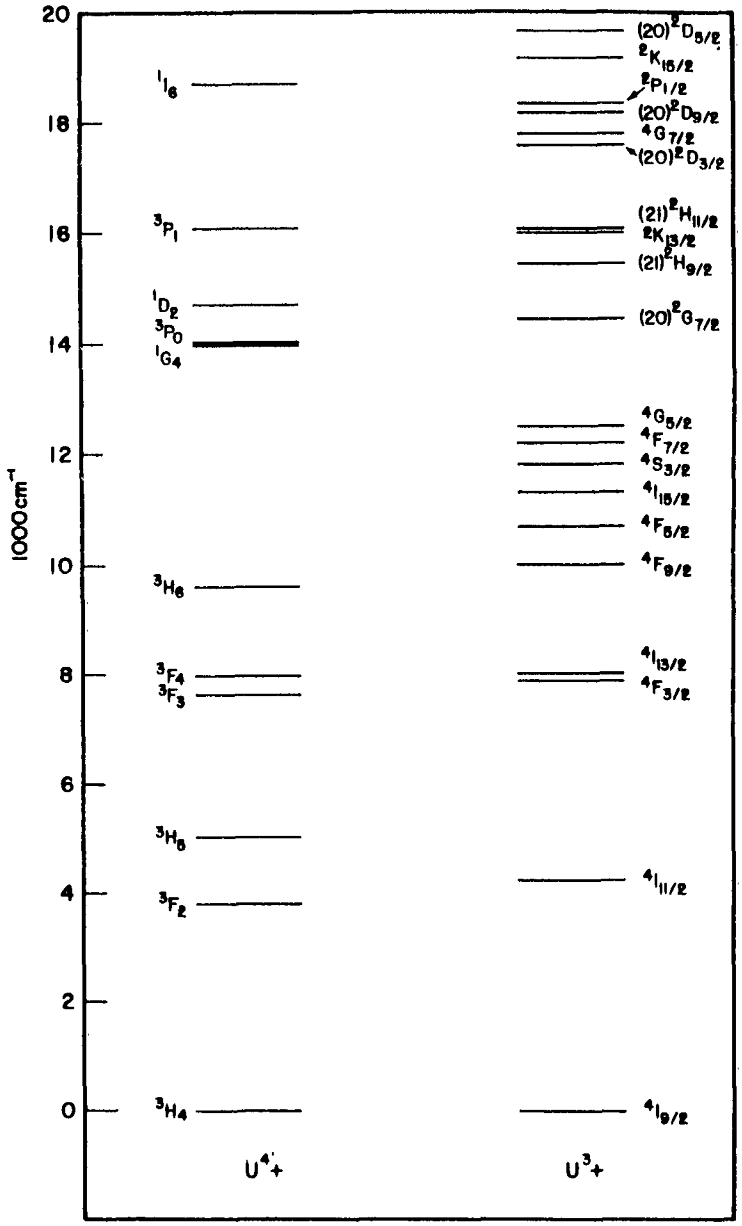

FIGURE 4 LOWER ENERGY LEVELS FOR U^{3+} AND U^{4+}.

```
X=  7.C, J=  1/2
EIGENVALUES
          21.714   45.335
EIGENVECTCRS
    2P  0.82131 -C.57C49
    4C  0.57C5C  C.82131
RECUCEC MATRIX ELEMENTS IN INTERMECIATE CCUPLING
  F2V2   C.CCCC   C.CCCC
  F4V4   C.CCCC   C.CCCC
  F6V6   C.CCCC   C.CCCC
     G  0.4497C  C.21697

X=  7.5, J=  1/2
EIGENVALUES
          2C.713   45.586
EIGENVECTCRS
    2P  0.8C665 -C.591C3
    4C  C.591C4  C.8C665
RECUCEC MATRIX ELEMENTS IN INTERMECIATE CCUPLING
  F2V2   C.CCCC   C.CCCC
  F4V4   C.CCCC   C.CCCC
  F6V6   C.CCCC   C.CCCC
     G  0.43379  C.23288

X=  8.C, J=  1/2
EIGENVALUES
          19.683   45.866
EIGENVECTCRS
    2P  0.79299 -C.60923
    4C  0.6C924  C.79299
RECUCEC MATRIX ELEMENTS IN INTERMECIATE CCUPLING
  F2V2   C.CCCC   C.CCCC
  F4V4   C.CCCC   C.CCCC
  F6V6   C.CCCC   C.CCCC
     G  0.41922  C.24745

X=  8.5, J=  1/2
EIGENVALUES
          18.629   46.17C
EIGENVECTCRS
    2P  0.78C3C -C.62541
    4C  C.62542  C.78C3C
RECUCEC MATRIX ELEMENTS IN INTERMECIATE CCUPLING
  F2V2   C.CCCC   C.CCCC
  F4V4   C.CCCC   C.CCCC
  F6V6   C.CCCC   C.CCCC
     G  0.4C591  C.26C76

X=  9.0, J=  1/2
EIGENVALUES
          17.555   46.494
EIGENVECTCRS
    2P  0.76853 -C.63981
    4C  C.63982  C.76853
RECUCED MATRIX ELEMENTS IN INTERMECIATE CCUPLING
  F2V2   C.CCCC   C.CCCC
  F4V4   C.CCCC   C.CCCC
  F6V6   C.CCCC   C.CCCC
     G  C.39376  C.27291

X=  9.5, J=  1/2
EIGENVALUES
          16.461   46.839
EIGENVECTCRS
    2P  C.75764 -C.65268
    4C  0.65269  C.75764
RECUCED MATRIX ELEMENTS IN INTERMECIATE CCUPLING
  F2V2   C.CCCC   C.CCCC
  F4V4   C.CCCC   C.CCCC
  F6V6   C.CCCC   C.CCCC
     G  C.38267  C.284CC

X= 1C.0, J=  1/2
EIGENVALUES
          15.353   47.196
EIGENVECTCRS
    2P  C.74755 -C.66421
    4C  C.66422  C.74755
RECUCED MATRIX ELEMENTS IN INTERMEDIATE CCUPLING
  F2V2   C.CCCC   C.CCCC
  F4V4   C.CCCC   C.CCCC
  F6V6   C.CCCC   C.CCCC
     G  C.37255  C.29412

X= 11.C, J=  1/2
EIGENVALUES
          13.C96   47.953
EIGENVECTCRS
    2P  C.72954 -C.68394
    4C  0.68395  C.72954
RECUCED MATRIX ELEMENTS IN INTERMECIATE CCUPLING
  F2V2   C.CCCC   C.CCCC
  F4V4   C.CCCC   C.CCCC
  F6V6   C.CCCC   C.CCCC
     G  C.35481  C.31186
```

TABLE I. WAVE FUNCTIONS, ENERGIES, AND REDUCED MATRIX ELEMENTS OF $5f^3$.

X= 7.0, J= 3/2

EIGENVALUES						
	-24.891	-8.878	17.332	34.471	50.233	67.271
EIGENVECTORS						
4S	-0.15247	0.83843	0.45368	0.13778	-0.20225	-0.08990
2P	-0.22134	0.43417	-0.45858	-0.27697	0.59253	0.35271
(20)2D	0.42828	-0.08179	0.51321	0.32595	0.53972	0.38598
(21)2D	-0.14578	0.00066	-0.25720	0.49605	-0.43382	0.69162
4D	-0.06836	0.07029	-0.34335	0.73992	0.29390	-0.48850
4F	0.84760	0.31132	-0.36939	-0.06724	-0.20527	-0.03953
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING						
F2V2	112.2228	78.7391	34.7212	-57.4063	-104.5398	176.2628
F4V4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F6V6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
G	0.56854	1.70728	1.15173	1.08088	1.05403	0.97088

X= 7.5, J= 3/2

EIGENVALUES						
	-27.293	-9.952	16.871	33.655	51.314	68.693
EIGENVECTORS						
4S	-0.15854	0.82349	0.46667	0.16369	-0.20407	-0.10254
2P	-0.23555	0.44612	-0.42854	-0.29986	0.57002	0.38344
(20)2D	0.44213	-0.09064	0.48746	0.34869	0.51780	0.41318
(21)2D	-0.15528	-0.00024	-0.28168	0.49222	-0.46297	0.66327
4D	-0.07551	0.07611	-0.37311	0.71603	0.32753	-0.47887
4F	0.83312	0.33250	-0.37736	-0.08203	-0.20906	-0.05015
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING						
F2V2	107.7710	85.9424	25.2438	-52.5226	-142.0223	215.5876
F4V4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F6V6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
G	0.59440	1.67800	1.15800	1.08250	1.04869	0.98175

X= 8.0, J= 3/2

EIGENVALUES						
	-29.747	-11.047	16.383	32.917	52.318	70.213
EIGENVECTORS						
4S	-0.16370	0.80940	0.47576	0.19116	-0.20497	-0.11482
2P	-0.24850	0.45630	-0.39772	-0.32109	0.54724	0.41144
(20)2D	0.45441	-0.07883	0.46035	0.37166	0.49559	0.43779
(21)2D	-0.16433	-0.00128	-0.30688	0.48521	-0.48959	0.63537
4D	-0.08247	0.08162	-0.40328	0.69074	0.35815	-0.46746
4F	0.81924	0.35184	-0.38307	-0.09848	-0.21200	-0.06057
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING						
F2V2	103.5677	92.7436	14.8283	-46.0971	-175.8461	250.8035
F4V4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F6V6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
G	0.59936	1.65034	1.16233	1.08580	1.04346	0.99205

X= 8.5, J= 3/2

EIGENVALUES						
	-32.245	-12.160	15.855	32.264	53.253	71.821
EIGENVECTORS						
4S	-0.16806	0.79618	0.48111	0.21976	-0.20515	-0.12654
2P	-0.26028	0.46500	-0.36634	-0.34052	0.52473	0.43650
(20)2D	0.46529	-0.07651	0.43201	0.39419	0.47368	0.45966
(21)2D	-0.17296	-0.00244	-0.33235	0.47532	-0.51333	0.60843
4D	-0.08920	0.08680	-0.43329	0.66404	0.38575	-0.45499
4F	0.80601	0.36944	-0.38664	-0.11620	-0.21423	-0.07056
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING						
F2V2	99.6159	99.1294	3.6662	-38.4231	-205.5405	281.5520
F4V4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F6V6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
G	0.61336	1.62442	1.16463	1.09077	1.03851	1.00165

X= 9.0, J= 3/2

EIGENVALUES						
	-34.784	-13.287	15.277	31.700	54.125	73.507
EIGENVECTORS						
4S	-0.17173	0.78383	0.48300	0.24894	-0.20483	-0.13754
2P	-0.27097	0.47245	-0.33469	-0.35794	0.50290	0.45861
(20)2D	0.47494	-0.07383	0.40272	0.41567	0.45254	0.47980
(21)2D	-0.18115	-0.00368	-0.35758	0.46295	-0.53413	0.58283
4D	-0.09569	0.09169	-0.46251	0.63613	0.41041	-0.44207
4F	0.79344	0.38543	-0.38824	-0.13475	-0.21591	-0.07998
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING						
F2V2	95.9103	105.1022	-7.9763	-29.8419	-231.0416	307.8472
F4V4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F6V6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
G	0.62640	1.60024	1.16496	1.09729	1.03395	1.01049

X= 9.5, J= 3/2

EIGENVALUES						
	-37.359	-14.427	14.643	31.227	54.943	75.262
EIGENVECTORS						
4S	-0.17482	0.77231	0.48181	0.27808	0.20418	-0.14776
2P	-0.28066	0.47884	-0.30316	-0.37314	-0.48207	0.47793
(20)2D	0.48350	-0.07089	0.37289	0.43560	-0.43247	0.49537
(21)2D	-0.18894	-0.00499	-0.38201	0.44857	0.55212	0.55884
4D	-0.10191	0.09629	-0.49029	0.60737	-0.43229	-0.42917
4F	0.78154	0.39993	-0.38807	-0.15362	0.21721	-0.08874
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING						
F2V2	92.4406	110.6751	-19.7803	-20.7323	-252.5767	329.9735
F4V4	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
F6V6	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
G	0.63852	1.57776	1.16349	1.10516	1.02985	1.01855

TABLE I CONTINUED.

```
X= 10.0, J=  3/2
EIGENVALUES
        -39.967  -15.577   13.948   30.844   55.713   77.076
EIGENVECTORS
    4S -0.17739  0.76159  0.47802  0.30654  0.20332 -0.15720
    2P -0.28945  0.48435 -0.27218 -0.38598 -0.46244  0.49468
(20)2D  0.49111 -0.06779  0.34298  0.45357 -0.41368  0.50964
(21)2D -0.19634 -0.00634 -0.40516  0.43274  0.56752  0.53659
    4D -0.10728  0.10062 -0.51605  0.57826 -0.45165 -0.41660
    4F  0.77031  0.41309 -0.38640 -0.17232  0.21820 -0.09681
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2  89.1934 115.8674 -31.4121 -11.4765-270.5437 348.3713
  F4V4   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
  F6V6   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
     G  0.64976  1.55692  1.16051  1.11409  1.02621  1.02584

X= 11.0, J=  3/2
EIGENVALUES
        -45.267  -17.903   12.377   30.338   57.140   80.852
EIGENVECTORS
    4S -0.13133  0.74234 -0.46487  0.35940  0.20140 -0.17335
    2P -0.30463  0.49326  0.21354 -0.40465 -0.42707  0.52169
(20)2D  0.50393 -0.06136 -0.22495  0.48294 -0.38016  0.53231
(21)2D -0.21003 -0.00913  0.44619  0.39599  0.59180  0.49732
    4D -0.11904  0.10855  0.56015  0.52115 -0.48378 -0.39324
    4F  0.74973  0.43589  0.37981 -0.20758  0.21968 -0.11097
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2  83.3071 125.2043 -53.0100   6.1669-297.6540 375.9855
  F4V4   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
  F6V6   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
     G  0.66979  1.51975  1.15145  1.13373  1.02026  1.03835

X=  7.0, J=  5/2
EIGENVALUES
        -13.529   -4.655   28.237   36.000   67.138   89.209  173.013
EIGENVECTORS
(20)2D  0.28903  0.05309  0.63889  0.68605  0.16119 -0.08973  0.02791
(21)2D  0.01579 -0.07459  0.48951 -0.26398 -0.41788  0.71369 -0.03003
    4D  0.00947 -0.05124  0.49409 -0.62344  0.54607 -0.25339  0.04566
(10)2F -0.10984  0.16756 -0.15162  0.10393  0.41277  0.43573  0.75223
(21)2F -0.11060  0.16020 -0.13858  0.12096  0.54404  0.44994 -0.65562
    4F  0.91934  0.24424 -0.21687 -0.19702  0.02210  0.09382 -0.00315
    4G -0.21597  0.93574  0.13732 -0.08200 -0.18536 -0.13144 -0.02310
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2   2.2915  38.5706  -2.8308  27.3777  -3.5396-110.6321-187.4275
  F4V4   3.1104 312.3182 -56.8759 -95.4076 -87.3803-133.1308 230.5260
  F6V6   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
     G  1.01748  0.62142  1.20747  1.24703  1.06955  1.06413  0.85864

X=  7.5, J=  5/2
EIGENVALUES
        -14.909   -6.429   27.184   35.886   67.421   90.878  173.631
EIGENVECTORS
(20)2D  0.29726  0.07094  0.55751  0.74733  0.16453 -0.09664  0.02998
(21)2D  0.02413 -0.08082  0.52089 -0.20970 -0.38956  0.72435 -0.03393
    4D  0.01435 -0.05664  0.54789 -0.56648  0.54934 -0.26704  0.04907
(10)2F -0.12594  0.17132 -0.16489  0.08989  0.41967  0.42866  0.74811
(21)2F -0.12534  0.16254 -0.15223  0.10857  0.55118  0.42874 -0.65977
    4F  0.90050  0.29297 -0.20463 -0.22613  0.02557  0.09796 -0.00389
    4G -0.26149  0.91850  0.15954 -0.07495 -0.19707 -0.13232 -0.02381
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2  -3.3788  45.0721 -17.1604  41.1664  -2.0754-112.1498-187.6645
  F4V4 -10.7063 323.8912 -86.4293 -61.9929 -84.5053-134.6862 227.5889
  F6V6   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
     G  1.00722  0.63643  1.21101  1.23590  1.06267  1.07355  0.85892

X=  8.0, J=  5/2
EIGENVALUES
        -16.373   -8.180   25.984   35.932   67.708   92.580  174.262
EIGENVECTORS
(20)2D  0.30295  0.09169  0.48887  0.78811  0.16757 -0.10302  0.03207
(21)2D  0.03379 -0.08609  0.54155 -0.16406 -0.36441  0.73282 -0.03804
    4D  0.02030 -0.06155  0.58425 -0.51898  0.55185 -0.27896  0.05252
(10)2F -0.14365  0.17254 -0.17415  0.07782  0.42515  0.42306  0.74397
(21)2F -0.14140  0.16241 -0.16163  0.09790  0.55657  0.40927 -0.66382
    4F  0.87683  0.34641 -0.19395 -0.24967  0.02884  0.10180 -0.00468
    4G -0.31178  0.89681  0.17981 -0.06819 -0.20796 -0.13308 -0.02443
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2  -9.3720  51.9078 -27.7368  51.1632  -0.8904-113.3889-187.8732
  F4V4 -23.9142 334.8038-108.7374 -36.0626 -81.8695-135.5572 224.4973
  F6V6   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
     G  0.99324  0.65530  1.21239  1.22720  1.05670  1.08164  0.85924
```

TABLE I CONTINUED.

```
X=  8.5, J=  5/2
EIGENVALUES
        -17.932   -9.895   24.688   36.088   67.999   94.308  174.906
EIGENVECTORS
(20)2D  0.30592  0.11489  0.43345  0.81447  0.17037 -0.10890  0.03420
(21)2D  0.04466 -0.09013  0.55496 -0.12717 -0.34202  0.73957 -0.04239
    4D  0.02728 -0.06575  0.60800 -0.48141  0.55375 -0.28937  0.05603
(10)2F -0.16259  0.17100 -0.18039  0.06803  0.42952  0.41877  0.73981
(21)2F -0.15841  0.15967 -0.16774  0.08932  0.56062  0.39125 -0.66778
    4F  0.84784  0.40291 -0.18562 -0.26873  0.03192  0.10544 -0.00554
    4G -0.36521  0.87023  0.19837 -0.06240 -0.21811 -0.13377 -0.02494
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2 -15.3394  58.7198 -35.3409  58.1577   0.0825-114.4166-188.0543
  F4V4 -35.3699 343.3208-124.6787 -16.7031 -79.4345-135.8211 221.2466
  F6V6   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
     G  0.97539  0.67814  1.21192  1.22058  1.05148  1.08859  0.85960
```

```
X=  9.0, J=  5/2
EIGENVALUES
        -19.594  -11.560   23.331   36.321   68.296   96.055  175.563
EIGENVECTORS
(20)2D  0.30576  0.13969  0.38912  0.83143  0.17297 -0.11434  0.03635
(21)2D  0.05645 -0.09277  0.56378 -0.09752 -0.32204  0.74495 -0.04696
    4D  0.03514 -0.06910  0.62340 -0.45221  0.55518 -0.29349  0.05960
(10)2F -0.18219  0.16677 -0.18446  0.06025  0.43300  0.41563  0.73561
(21)2F -0.17582  0.15444 -0.17149  0.08259  0.56362  0.37447 -0.67165
    4F  0.81371  0.46003 -0.17949 -0.28450  0.03481  0.10388 -0.00647
    4G -0.41937  0.83895  0.21557 -0.05764 -0.22759 -0.13441 -0.02536
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2 -20.8369  65.0600 -40.8819  63.0676   0.8931-115.2838-188.2085
  F4V4 -43.9415 350.1196-135.8950  -2.2443 -77.1691-135.5414 217.8319
  F6V6   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
     G  0.95418  0.70442  1.21014  1.21551  1.04688  1.09458  0.86000
```

```
X=  9.5, J=  5/2
EIGENVALUES
        -21.365  -13.168   21.939   36.607   68.600   97.816  176.233
EIGENVECTORS
(20)2D  0.30299  0.16497  0.35342  0.84238  0.17538 -0.11936  0.03854
(21)2D  0.06876 -0.09401  0.56966 -0.07345 -0.30414  0.74923 -0.05176
    4D  0.04358 -0.07154  0.63338 -0.42952  0.55623 -0.30649  0.06323
(10)2F -0.20169  0.16021 -0.18698  0.05404  0.43577  0.41351  0.73136
(21)2F -0.19293  0.14711 -0.17354  0.07733  0.56580  0.35872 -0.67545
    4F  0.77551  0.51493 -0.17515 -0.29787  0.03754  0.11215 -0.00746
    4G -0.47144  0.80398  0.23166 -0.05379 -0.23646 -0.13502 -0.02569
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2 -25.4424  70.5033 -45.0447  66.5858   1.5784-116.0287-188.3359
  F4V4 -48.8856 352.6663-143.7998   8.7494 -75.0485-134.7696 214.2479
  F6V6   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
     G  0.93081  0.73291  1.20747  1.21155  1.04279  1.09975  0.86045
```

```
X= 10.0, J=  5/2
EIGENVALUES
        -23.244  -14.716   20.525   36.931   68.912   99.589  176.917
EIGENVECTORS
(20)2D  0.29806  0.18957  0.32426  0.84941  0.17764 -0.12401  0.04077
(21)2D  0.08112 -0.09401  0.57363 -0.05360 -0.28806  0.75264 -0.05679
    4D  0.05229 -0.07313  0.63984 -0.41174  0.55698 -0.31351  0.06693
(10)2F -0.22043  0.15158 -0.18835  0.04905  0.43799  0.41229  0.72707
(21)2F -0.20912  0.13835 -0.17435  0.07321  0.56736  0.34382 -0.67916
    4F  0.73503  0.56513 -0.17216 -0.30947  0.04011  0.11525 -0.00852
    4G -0.51890  0.76700  0.24681 -0.05067 -0.24477 -0.13561 -0.02593
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2 -28.9057  74.7772 -48.2832  69.1732   2.1659-116.6307-188.4369
  F4V4 -50.1219 351.4905-149.4069  17.3089 -73.0532-133.5466 210.4893
  F6V6   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
     G  0.90695  0.76191  1.20423  1.20837  1.03911  1.10420  0.86094
```

```
X= 11.0, J=  5/2
EIGENVALUES
        -27.305  -17.645   17.670   37.656   69.553  103.152  178.325
EIGENVECTORS
(20)2D  0.28461  0.23354  0.27970  0.85653  0.18176 -0.13230  0.04534
(21)2D  0.10463 -0.09141  0.57804 -0.02275 -0.26044  0.75741 -0.06755
    4D  0.06933 -0.07444  0.64652 -0.38638  0.55778 -0.32513  0.07455
(10)2F -0.25384  0.13345 -0.18867  0.04162  0.44115  0.41218  0.71828
(21)2F -0.23732  0.11935 -0.17344  0.06735  0.56907  0.31604 -0.68636
    4F  0.65504  0.64610 -0.16896 -0.32838  0.04483  0.12102 -0.01084
    4G -0.59448  0.69432  0.27466 -0.04604 -0.25993 -0.13678 -0.02613
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2 -32.3355  79.7791 -53.0462  72.6376   3.1252-117.7911-188.5595
  F4V4 -44.0673 340.6062-156.2565  29.7038 -69.3787-129.8718 202.4244
  F6V6   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000   0.0000
     G  0.86372  0.81538  1.19682  1.20357  1.03276  1.11136  0.86209
```

TABLE I CONTINUED.

```
X=  7.0, J=  7/2
EIGENVALUES
        -7.274    2.983   16.571   52.382   89.966  106.426  166.943
EIGENVECTORS
    4D  0.01288 -0.02448 -0.02632  0.97400  0.19143 -0.03254  0.11037
(10)2F -0.05546  0.08815  0.07008 -0.18587  0.45994 -0.11516  0.85141
(21)2F -0.07798  0.10413  0.07613 -0.09747  0.83260  0.25278 -0.45898
    4F  0.78065 -0.44564  0.42776 -0.02735  0.08548  0.02786  0.01341
(20)2G -0.44474 -0.22330  0.57272  0.05465 -0.17136  0.61153  0.13423
(21)2G  0.37360  0.24048 -0.46933  0.00752 -0.07576  0.73756  0.18040
    4G  0.20952  0.82129  0.50730  0.05917 -0.12724 -0.05523 -0.03894
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2  52.9586 -29.4366  53.4396 -92.8409 -29.9299 -97.9695-116.2687
  F4V4  29.8705 -22.3802  36.4229  29.9239 -35.9222  45.8055  49.2103
  F6V6 -53.1998  56.8677  29.8592  11.3233 -50.3337-143.7833  96.4088
     G  1.10830  1.02753  0.98039  1.41264  1.14254  0.90962  1.13327
```

```
X=  7.5, J=  7/2
EIGENVALUES
        -8.251    2.124   16.839   52.532   90.846  106.409  167.499
EIGENVECTORS
    4D  0.01373 -0.02787 -0.02829  0.97132  0.19926 -0.03924  0.11836
(10)2F -0.05646  0.09610  0.07073 -0.19493  0.44945 -0.12503  0.85262
(21)2F -0.08003  0.11411  0.07614 -0.09837  0.83283  0.26837 -0.44662
    4F  0.76027 -0.45700  0.45072 -0.02960  0.08933  0.03016  0.01505
(20)2G -0.45866 -0.19407  0.57153  0.06111 -0.18151  0.60685  0.14274
(21)2G  0.38680  0.21866 -0.46944  0.00924 -0.08182  0.73367  0.19275
    4G  0.22351  0.82623  0.48809  0.06457 -0.13217 -0.05874 -0.04265
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2  54.1019 -30.1374  54.2096 -92.8749 -30.4294-100.4499-113.4673
  F4V4  31.4531 -23.2056  36.4603  29.3395 -37.3421  48.3260  47.8997
  F6V6 -46.9538  55.6150  24.3948  12.0029 -48.6710-147.3996  98.1541
     G  1.09824  1.03291  0.98569  1.41087  1.14200  0.91258  1.13198
```

```
X=  8.0, J=  7/2
EIGENVALUES
        -9.260    1.254   17.129   52.666   91.724  106.364  168.119
EIGENVECTORS
    4D  0.01449 -0.03129 -0.03023  0.96863  0.20433 -0.04448  0.12626
(10)2F -0.05721  0.10373  0.07123 -0.20360  0.43892 -0.13487  0.85358
(21)2F -0.08175  0.12372  0.07591 -0.09856  0.83306  0.28322 -0.43397
    4F  0.74110 -0.46629  0.47157 -0.03173  0.09295  0.03245  0.01676
(20)2G -0.47046 -0.16719  0.56953  0.06774 -0.19127  0.60200  0.15090
(21)2G  0.39327  0.19861 -0.46893  0.01115 -0.08774  0.72960  0.20475
    4G  0.24630  0.82954  0.47077  0.06985 -0.13671 -0.06215 -0.04643
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2  55.0544 -31.4591  54.7779 -92.9125 -30.9428-102.8838-110.6815
  F4V4  32.8435 -23.7622  36.3959  28.7784 -38.7160  50.7308  46.6554
  F6V6 -41.1324  54.3267  19.3477  12.5921 -46.8512-150.6840  99.5433
     G  1.08910  1.03750  0.99089  1.40905  1.14139  0.91568  1.13067
```

```
X=  8.5, J=  7/2
EIGENVALUES
       -10.296    0.372   17.439   52.786   92.599  106.292  168.804
EIGENVECTORS
    4D  0.01519 -0.03471 -0.03214  0.96591  0.20968 -0.05126  0.13404
(10)2F -0.05775  0.11102  0.07163 -0.21193  0.42839 -0.14463  0.85432
(21)2F -0.08318  0.13296  0.07549 -0.09808  0.83332  0.29725 -0.42108
    4F  0.72316 -0.47381  0.49049 -0.03371  0.09637  0.03471  0.01853
(20)2G -0.48044 -0.14255  0.56695  0.07452 -0.20059  0.59705  0.15867
(21)2G  0.40822  0.18025 -0.46797  0.01325 -0.09345  0.72536  0.21637
    4G  0.26285  0.83156  0.45513  0.07499 -0.14089 -0.06545 -0.05027
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2  55.8332 -32.4643  55.1846 -92.9544 -31.4737-105.2538-107.9240
  F4V4  34.0734 -24.0929  36.2557  28.2456 -40.0400  53.0074  45.4817
  F6V6 -35.7365  53.0391  14.6892  13.0853 -44.8761-153.6377 100.5789
     G  1.08082  1.04141  0.99593  1.40718  1.14071  0.91889  1.12934
```

```
X=  9.0, J=  7/2
EIGENVALUES
       -11.355   -0.522   17.766   52.892   93.469  106.195  169.551
EIGENVECTORS
    4D  0.01582 -0.03811 -0.03405  0.96317  0.21434 -0.05861  0.14170
(10)2F -0.05813  0.11798  0.07198 -0.21996  0.41784 -0.15431  0.85484
(21)2F -0.08438  0.14182  0.07492 -0.09695  0.83365  0.31035 -0.40801
    4F  0.70646 -0.47984  0.50766 -0.03554  0.09960  0.03694  0.02037
(20)2G -0.48887 -0.11999  0.56396  0.08143 -0.20942  0.59204  0.16603
(21)2G  0.41628  0.16346 -0.46672  0.01554 -0.09888  0.72101  0.22756
    4G  0.27820  0.83256  0.44098  0.07998 -0.14476 -0.06861 -0.05416
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2  56.4761 -33.2087  55.4620 -93.0011 -32.0275-107.5418-105.2064
  F4V4  35.1460 -24.2370  36.0601  27.7452 -41.3089  55.1433  44.3821
  F6V6 -30.7529  51.7749  10.3888  13.4776 -42.7447-156.2695 101.2682
     G  1.07334  1.04473  1.00077  1.40527  1.13998  0.92218  1.12801
```

```
X=  9.5, J=  7/2
EIGENVALUES
       -12.434   -1.426   18.108   52.984   94.332  106.074  170.360
EIGENVECTORS
    4D  0.01639 -0.04148 -0.03595  0.96040  0.21834 -0.06655  0.14922
(10)2F -0.05827  0.12462  0.07229 -0.22771  0.40727 -0.16388  0.85514
(21)2F -0.08539  0.15029  0.07424 -0.09521  0.83410  0.32242 -0.39481
    4F  0.69095 -0.48463  0.52325 -0.03721  0.10266  0.03912  0.02226
(20)2G -0.49598 -0.09935  0.56070  0.08847 -0.21771  0.58703  0.17298
(21)2G  0.42442  0.14812 -0.46528  0.01801 -0.10394  0.71660  0.23835
    4G  0.29240  0.83276  0.42816  0.08480 -0.14834 -0.07163 -0.05808
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2  56.9897 -33.7403  55.6363 -93.0536 -32.6117-109.7285-102.5393
  F4V4  36.0846 -24.2294  35.8252  27.2811 -42.5152  57.1260  43.3585
  F6V6 -26.1597  50.5472   6.4160  13.7649 -40.4514-158.5973 101.6226
     G  1.06660  1.04756  1.00538  1.40331  1.13921  0.92552  1.12670
```

TABLE I CONTINUED.

X= 10.0, J= 7/2

EIGENVALUES

	-13.530	-2.347	18.463	53.062	95.189	105.931	171.229
EIGENVECTORS							
4D	0.01690	-0.04481	-0.03736	0.95759	0.22169	-0.07510	0.15658
(10)2F	-0.05850	0.13095	0.07259	-0.23523	0.39666	-0.17334	0.85525
(21)2F	-0.08675	0.15840	0.07346	-0.09288	0.33475	0.33330	-0.38153
4F	0.67656	-0.48838	0.53743	-0.03870	0.10558	0.04122	0.02419
(20)2G	-0.50200	-0.08047	0.55727	0.09561	-0.22536	0.58209	0.17950
(21)2G	0.43102	0.13412	-0.46373	0.02065	-0.10849	0.71215	0.24866
4G	0.30553	0.83234	0.41651	0.08945	-0.15168	-0.07447	-0.06202
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING							
F2V2	57.3987	-34.0998	55.7283	-93.1126	-33.2378	-111.7922	-99.9320
F4V4	36.9068	-24.1000	35.5636	26.8568	-43.6498	58.9419	42.4117
F6V6	-21.9304	49.3631	2.7412	13.9439	-37.9836	-160.6491	101.6573
G	1.06053	1.04997	1.00975	1.40129	1.13842	0.92890	1.12542

X= 11.0, J= 7/2

EIGENVALUES

	-15.766	-4.220	19.208	53.175	96.877	105.584	173.139
EIGENVECTORS							
4D	0.01780	-0.05128	-0.04174	0.95184	0.22643	-0.09422	0.17079
(10)2F	-0.05853	0.14272	0.07323	-0.24965	0.37515	-0.19213	0.85491
(21)2F	-0.08761	0.17355	0.07170	-0.08660	0.83707	0.35059	-0.35492
4F	0.65087	-0.49346	0.56214	-0.04111	0.11110	0.04507	0.02817
(20)2G	-0.51138	-0.04738	0.55016	0.11021	-0.23823	0.57230	0.19124
(21)2G	0.44193	0.10962	-0.46053	0.02646	-0.11534	0.70346	0.26785
4G	0.32885	0.83013	0.39622	0.09819	-0.15782	-0.07949	-0.06992
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING							
F2V2	57.9695	-34.4323	55.7273	-93.2533	-34.6912	-115.4410	-94.9264
F4V4	36.2627	-23.5726	34.9956	26.1388	-45.6420	62.0023	40.7461
F6V6	-14.4493	47.1352	-3.8262	13.9661	-32.4194	-164.1062	100.8421
G	1.05011	1.05379	1.01780	1.39708	1.13693	0.93558	1.12298

X= 7.0, J= 9/2

EIGENVALUES

	-62.032	-16.837	5.534	18.700	36.914	56.812	102.709
EIGENVECTORS							
4F	0.02003	-0.33705	0.80657	-0.06924	0.47317	0.06776	0.04659
(20)2G	-0.06560	0.42480	-0.21011	0.01095	0.59463	0.04950	0.64417
(21)2G	0.06036	-0.36568	0.10772	0.09734	-0.45886	-0.31629	0.72867
4G	0.03494	-0.23576	-0.11952	0.92832	0.14453	0.21026	-0.04528
(11)2H	0.11010	-0.23518	-0.11648	-0.24545	-0.15745	0.88895	0.20954
(21)2H	-0.33039	0.60365	0.49220	0.24065	-0.40209	0.24216	0.07731
4I	0.93229	0.31135	0.15359	0.07544	-0.06792	-0.00452	0.00151
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING							
F2V2	-30.5266	38.5259	25.3452	-4.2063	31.8336	-40.9707	-68.4859
F4V4	-19.7803	3.1603	-18.4118	10.0020	12.1995	0.6014	4.1292
F6V6	-151.1799	106.0963	-32.2719	41.4147	-23.5746	50.8922	-76.1403
G	0.75316	1.01773	1.19581	1.13835	1.12269	0.94335	1.10164

X= 7.5, J= 9/2

EIGENVALUES

	-64.621	-18.315	5.786	18.813	38.528	57.019	102.841
EIGENVECTORS							
4F	0.02214	-0.33669	0.80150	-0.05287	0.48042	0.08709	0.05074
(20)2G	-0.07074	0.42814	-0.21670	0.02303	0.58637	0.07151	0.64442
(21)2G	0.06529	-0.36915	0.10536	0.09590	-0.44006	-0.34915	0.72360
4G	0.03813	-0.24122	-0.13432	0.92397	0.11847	0.22885	-0.04692
(11)2H	0.11388	-0.23023	-0.10671	-0.26011	-0.19935	0.87489	0.22320
(21)2H	-0.34377	0.59195	0.49476	0.24409	-0.41591	0.21804	0.08039
4I	0.92609	0.32476	0.15917	0.08082	-0.07042	-0.00806	0.00153
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING							
F2V2	-29.7618	38.3364	23.2031	-2.8572	26.8915	-36.9554	-67.3434
F4V4	-19.3396	3.0453	-18.5876	10.4027	12.7068	-0.2940	3.9669
F6V6	-147.2095	102.6629	-34.7346	45.9943	-16.4263	42.0054	-77.0626
G	0.75562	1.01785	1.19348	1.13526	1.11837	0.95171	1.10043

X= 8.0, J= 9/2

EIGENVALUES

	-67.237	-19.780	6.022	18.916	40.048	57.334	102.998
EIGENVECTORS							
4F	0.02422	-0.33645	0.79650	-0.03532	0.48514	0.11029	0.05507
(20)2G	-0.07569	0.43094	-0.22333	0.03346	0.57643	0.09738	0.64484
(21)2G	0.07006	-0.37215	0.10240	0.09577	-0.41700	-0.38380	0.71815
4G	0.04126	-0.24613	-0.15029	0.91856	0.09026	0.24679	-0.04832
(11)2H	0.11732	-0.22557	-0.09583	-0.27486	-0.24655	0.85664	0.23663
(21)2H	-0.35623	0.58020	0.49652	0.24839	-0.42929	0.19017	0.08417
4I	0.92001	0.33734	0.16409	0.03644	-0.07242	-0.01233	0.00151
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING							
F2V2	-29.0088	38.1157	20.9232	-1.3841	20.9027	-31.8291	-66.2044
F4V4	-18.9060	2.9154	-18.7739	10.7896	13.2087	-1.0957	3.7624
F6V6	-143.3004	99.2042	-37.1212	50.5020	-7.7020	31.6117	-77.9577
G	0.75804	1.01783	1.19147	1.13193	1.11238	0.96189	1.09918

TABLE I CONTINUED.

```
X=  8.5, J=  9/2
EIGENVALUES
       -69.878  -21.232    6.241   19.010   41.451   57.779  103.181
EIGENVECTORS
    4F  0.02624 -0.33630  0.79145 -0.01652  0.48698  0.13730  0.05960
(20)2G -0.08043  0.43330 -0.23009  0.04239  0.56425  0.12675  0.64545
(21)2G  0.07466 -0.37475  0.09886  0.09672 -0.38907 -0.41964  0.71231
    4G  0.04430 -0.25057 -0.16741  0.91208  0.05940  0.26337 -0.04948
(11)2H  0.12046 -0.22119 -0.08380 -0.28960 -0.29835  0.83320  0.24986
(21)2H -0.36783  0.57018  0.49751  0.25357 -0.44170  0.15844  0.08714
    4I  0.91406  0.34914  0.16833  0.09232 -0.07385 -0.01732  0.00145
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2 -28.2704  37.3665  18.4934   0.2187  13.8102 -25.5362 -65.0668
  F4V4 -18.4809   2.7750 -18.9634  11.1594  13.6331  -1.7356   3.5128
  F6V6-139.4721  95.7413 -39.4186  54.9460   2.4681  19.8055 -78.8337
     G  0.76042  1.01770  1.18971  1.12938  1.10453  0.97407  1.09790
```

```
X=  9.0, J=  9/2
EIGENVALUES
       -72.543  -22.671    6.440   19.097   42.717   58.374  103.387
EIGENVECTORS
    4F  0.02922 -0.33622  0.78621  0.00356  0.48562  0.16755  0.06434
(20)2G -0.03497  0.43529 -0.23704  0.04994  0.54935  0.15868  0.64627
(21)2G  0.07911 -0.37702  0.09476  0.09859 -0.35610 -0.45560  0.70605
    4G  0.04726 -0.25461 -0.18565  0.90450  0.02578  0.27778 -0.05039
(11)2H  0.12334 -0.21706 -0.07057 -0.30421 -0.35317  0.80394  0.26287
(21)2H -0.37865  0.56004  0.49772  0.25966 -0.45234  0.12318  0.08977
    4I  0.90825  0.36021  0.17190  0.09848 -0.07464 -0.02294  0.00133
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2 -27.5489  37.5977  15.9035   1.9570   5.7190 -18.1847 -63.9283
  F4V4 -18.0655   2.6276 -19.1481  11.5072  13.8981  -2.1335   3.2148
  F6V6-135.7360  92.3100 -41.6033  59.3157  13.7014   6.9479 -79.6991
     G  0.76275  1.01748  1.18817  1.12466  1.09488  0.98819  1.09668
```

```
X=  9.5, J=  9/2
EIGENVALUES
       -75.229  -24.099    6.617   19.178   43.829   59.137  103.618
EIGENVECTORS
    4F  0.03013 -0.33617  0.78064  0.02490  0.48097  0.19984  0.06932
(20)2G -0.08931  0.43697 -0.24420  0.05617  0.53157  0.19159  0.64733
(21)2G  0.08338 -0.37901  0.09010  0.10122 -0.31867 -0.49029  0.69936
    4G  0.05013 -0.25829 -0.20497  0.89576 -0.01017  0.28925 -0.05103
(11)2H  0.12597 -0.21317 -0.05610 -0.31856 -0.40852  0.76888  0.27567
(21)2H -0.38874  0.55036  0.49714  0.26666 -0.46040  0.08540  0.09207
    4I  0.90259  0.37061  0.17480  0.10494 -0.07473 -0.02900  0.00116
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2 -26.8460  37.3152  13.1466   3.8343  -3.0459 -10.1036 -62.7853
  F4V4 -17.6608   2.4758 -19.3191  11.8260  13.9300  -2.2164   2.8649
  F6V6-132.1015  88.9322 -43.6423  63.5842  25.3236  -6.2967 -80.5628
     G  0.76503  1.01718  1.18678  1.12079  1.08384  1.00383  1.09527
```

```
X= 10.0, J=  9/2
EIGENVALUES
       -77.935  -25.516    6.768   19.257   44.779   60.074  103.874
EIGENVECTORS
    4F  0.03198 -0.33616  0.77460  0.04748  0.47340  0.23249  0.07456
(20)2G -0.09345  0.43839 -0.25160  0.06114  0.51126  0.22349  0.64863
(21)2G  0.08749 -0.38076  0.08486  0.10445 -0.27813 -0.52226  0.69220
    4G  0.05291 -0.26165 -0.22529  0.88583 -0.04749  0.29732 -0.05141
(11)2H  0.12837 -0.20950 -0.04038 -0.33250 -0.46142  0.72900  0.28829
(21)2H -0.39816  0.54112  0.49576  0.27456 -0.46527  0.04665  0.09401
    4I  0.89710  0.38036  0.17701  0.11170 -0.07417 -0.03521  0.00092
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING -
  F2V2 -26.1627  37.0236  10.2200   5.8512 -11.9665  -1.8165 -61.6338
  F4V4 -17.2671   2.3218 -19.4666  12.1075  13.6894  -1.9442   2.4597
  F6V6-128.5747  85.6240 -45.4928  67.7099  36.4706 -19.0664 -81.4340
     G  0.76725  1.01682  1.18551  1.11682  1.07219  1.02020  1.09393
```

```
X= 11.0, J=  9/2
EIGENVALUES
       -83.398  -28.321    6.980   19.415   46.222   62.445  104.458
EIGENVECTORS
    4F  0.03549 -0.33620  0.76060  0.09597  0.45297  0.29229  0.08594
(20)2G -0.10115  0.44059 -0.26710  0.06740  0.46663  0.27715  0.65209
(21)2G  0.09522 -0.38365  0.07269  0.11224 -0.19559 -0.57459  0.67635
    4G  0.05818 -0.26758 -0.26832  0.86220 -0.12148  0.30370 -0.05134
(11)2H  0.13259 -0.20274 -0.00526 -0.35855 -0.54984  0.64222  0.31298
(21)2H -0.41522  0.52387  0.49056  0.29296 -0.46539 -0.02695  0.09680
    4I  0.88661  0.39815  0.17942  0.12604 -0.07164 -0.04695  0.00023
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2 -24.8579  36.4272   3.8794  10.2791 -28.0794  13.1508 -59.2839
  F4V4 -16.5145   2.0133 -19.6496  12.5208  12.4803  -0.4163   1.4665
  F6V6-121.8586  79.2592 -48.4198  75.3120  54.3491 -40.1685 -53.2367
     G  0.77149  1.01598  1.18305  1.10880  1.05080  1.05137  1.09123
```

TABLE I CONTINUED.

X= 7.0, J= 11/2

EIGENVALUES

	-44.734	8.959	30.326	39.821	72.404

EIGENVECTORS

4G	0.02769	-0.44293	0.69939	-0.48852	0.27431
(11)2H	0.07398	-0.25566	-0.61274	-0.24711	0.70189
(21)2H	-0.18294	0.82143	0.22916	-0.16940	0.45891
2I	-0.03006	-0.17713	0.27720	0.81909	0.46902
4I	0.97949	0.17982	0.07783	0.02598	0.03935

REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING

F2V2	-3.8749	0.6147	-2.0331	-7.1947	-3.9488
F4V4	-10.6834	3.8471	14.5828	28.2027	10.5498
F6V6	-20.4488	-26.5054	-13.3387	-11.6099	62.7741
G	0.97013	1.11724	1.16618	1.02162	1.06748

X= 7.5, J= 11/2

EIGENVALUES

	-45.849	9.068	30.553	39.823	73.929

EIGENVECTORS

4G	0.02998	-0.45817	0.62845	-0.55659	0.29058
(11)2H	0.07707	-0.23432	-0.65612	-0.18406	0.68904
(21)2H	-0.19011	0.81395	0.22705	-0.18062	0.46603
2I	-0.03132	-0.19652	0.33964	0.78945	0.47098
4I	0.97778	0.18448	0.08747	0.02174	0.04249

REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING

F2V2	-3.8550	0.4905	-2.8633	-6.3023	-3.9067
F4V4	-10.5973	4.8420	13.4450	27.4958	11.3133
F6V6	-20.2821	-27.8522	-8.9124	-14.1700	62.0880
G	0.97057	1.11831	1.14239	1.04258	1.06880

X= 8.0, J= 11/2

EIGENVALUES

	-46.971	9.133	30.613	40.005	75.496

EIGENVECTORS

4G	0.03222	-0.47200	0.55144	-0.61508	0.30621
(11)2H	0.07997	-0.21135	-0.69114	-0.11644	0.67654
(21)2H	-0.19684	0.80622	0.22589	-0.19098	0.47304
2I	-0.03250	-0.21704	0.39720	0.75589	0.47192
4I	0.97610	0.18826	0.09721	0.01650	0.04559

REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING

F2V2	-3.8357	0.3463	-3.6986	-5.3870	-3.8618
F4V4	-10.5129	5.9103	12.5487	26.4903	12.0625
F6V6	-20.1196	-29.1512	-4.7940	-16.3877	61.3240
G	0.97099	1.11905	1.11853	1.06377	1.07032

X= 8.5, J= 11/2

EIGENVALUES

	-48.101	9.150	30.532	40.344	77.101

EIGENVECTORS

4G	0.03441	-0.48440	0.47385	0.66067	0.32119
(11)2H	0.08271	-0.18675	-0.71720	0.05019	0.66437
(21)2H	-0.20317	0.79813	0.22724	0.19949	0.47969
2I	-0.03363	-0.23864	0.44500	-0.72186	0.47203
4I	0.97446	0.19113	0.10688	-0.01090	0.04863

REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING

F2V2	-3.8168	0.1795	-4.4371	-4.5479	-3.8146
F4V4	-10.4305	7.0517	11.8203	25.2643	12.7931
F6V6	-19.9618	-30.3862	-1.2879	-17.9907	60.4979
G	0.97141	1.11942	1.09706	1.08280	1.07197

X= 9.0, J= 11/2

EIGENVALUES

	-49.238	9.114	30.347	40.809	78.743

EIGENVECTORS

4G	0.03654	-0.49532	0.40003	0.69336	0.33551
(11)2H	0.08529	-0.16059	-0.73556	-0.01057	0.65252
(21)2H	-0.20912	0.78954	0.23205	0.20574	0.48656
2I	-0.03470	-0.26120	0.48116	-0.69050	0.47146
4I	0.97286	0.19309	0.11651	-0.00551	0.05161

REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING

F2V2	-3.7984	-0.0119	-5.0176	-3.8436	-3.7653
F4V4	-10.3501	8.2627	11.1525	23.9323	13.5016
F6V6	-19.8085	-31.5380	1.5033	-18.9089	59.6235
G	0.97182	1.11937	1.07944	1.09829	1.07374

X= 9.5, J= 11/2

EIGENVALUES

	-50.380	9.022	30.098	41.366	80.419

EIGENVECTORS

4G	0.03861	-0.50470	0.33211	0.71525	0.34916
(11)2H	0.08773	-0.13299	-0.74809	-0.06411	0.64099
(21)2H	-0.21474	0.78034	0.24054	0.20988	0.49301
2I	-0.03571	-0.28456	0.50625	-0.66352	0.47033
4I	0.97130	0.19414	0.12616	-0.00063	0.05453

REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING

F2V2	-3.7806	-0.2294	-5.4267	-3.2857	-3.7144
F4V4	-10.2718	9.5359	10.4588	22.5906	14.1854
F6V6	-19.6600	-32.5858	3.6309	-19.2270	58.7132
G	0.97221	1.11889	1.06595	1.11003	1.07557

TABLE I CONTINUED

```
X= 10.0, J= 11/2
EIGENVALUES
        -51.529     8.871    29.819    41.986    82.128
EIGENVECTORS
    4G  0.04063 -0.51248 -0.27047 -0.72898  0.36213
(11)2H  0.09004 -0.10414  0.75647  0.11042  0.62978
(21)2H -0.22004  0.77046 -0.25237 -0.21226  0.49924
    2I -0.03667 -0.30849 -0.52195  0.64135  0.46875
    4I  0.96979  0.19429 -0.13590 -0.00362  0.05738
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2  -3.7633  -0.4734  -5.6798  -2.8578  -3.6625
  F4V4 -10.1956  10.8594   9.6943  21.2980  14.8427
  F6V6 -19.5161 -33.5080   5.2038 -19.0861  57.7777
     G  0.97260  1.11794  1.05616  1.11849  1.07746


X= 11.0, J= 11/2
EIGENVALUES
        -53.841     8.375    29.268    43.337    85.636
EIGENVECTORS
    4G  0.04449 -0.52305 -0.16381 -0.74061  0.38612
(11)2H  0.09430 -0.04389  0.76489  0.18463  0.60832
(21)2H -0.22990  0.74847 -0.28359 -0.21329  0.51095
    2I -0.03847 -0.35693 -0.53241  0.60976  0.46460
    4I  0.96687  0.19204 -0.15565 -0.01036  0.06285
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2  -3.7302  -1.0355  -5.8216  -2.2928  -3.5567
  F4V4 -10.0493  13.5891   7.9357  18.9502  16.0731
  F6V6 -19.2419 -34.9007   7.0807 -17.9343  55.8676
     G  0.97335  1.11463  1.04516  1.12822  1.08129


X=  7.0, J= 13/2
EIGENVALUES
        -29.022    10.009    51.564
EIGENVECTORS
    2I -0.07516 -0.19383  0.97816
    4I  0.97615 -0.21466  0.03247
    2K  0.20369  0.95726  0.20535
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2 -20.3037 -56.2379 -37.3045
  F4V4  -3.3937  -5.0069   4.3037
  F6V6  -3.5841   1.6942   1.1076
     G  1.10028  0.94676  1.07090


X=  7.5, J= 13/2
EIGENVALUES
        -29.102     9.456    51.946
EIGENVECTORS
    2I -0.08229 -0.20043  0.97625
    4I  0.97152 -0.23455  0.03374
    2K  0.22223  0.95122  0.21403
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2 -20.6558 -55.8811 -37.3092
  F4V4  -3.3935  -4.9219   4.2186
  F6V6  -3.5210   1.6958   1.0428
     G  1.09887  0.94869  1.07038


X=  8.0, J= 13/2
EIGENVALUES
        -29.216     8.931    52.336
EIGENVECTORS
    2I -0.08962 -0.20630  0.97438
    4I  0.96635 -0.25487  0.03493
    2K  0.24115  0.94471  0.22221
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2 -21.0470 -55.4826 -37.3165
  F4V4  -3.3931  -4.8407   4.1370
  F6V6  -3.4506   1.6863   0.9819
     G  1.09731  0.95077  1.06987


X=  8.5, J= 13/2
EIGENVALUES
        -29.365     8.434    52.732
EIGENVECTORS
    2I -0.09714 -0.21147  0.97255
    4I  0.96062 -0.27555  0.03604
    2K  0.26037  0.93774  0.22991
REDUCED MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2 -21.4778 -55.0421 -37.3261
  F4V4  -3.3924  -4.7632   4.0588
  F6V6  -3.3730   1.6661   0.9245
     G  1.09558  0.95299  1.06937
```

TABLE I CONTINUED

```
X=  9.C, J= 13/2
EIGENVALUES
        -29.55C    7.967   53.134
EIGENVECTCRS
    2I -0.10481 -C.21596  0.97076
    4I  0.95432 -C.2965C  C.03708
    2K  0.27983  C.93C3C  0.23718
REDUCEC MATRIX ELEMENTS IN INTERMEDIATE CCUPLING
  F2V2 -21.9481 -54.5604 -37.3375
  F4V4  -3.3914  -4.6893   3.9839
  F6V6  -3.288C   1.6352   0.8704
     G  1.C937C  C.95536  1.06889


X=  9.5, J= 13/2
EIGENVALUES
        -29.773    7.532   53.542
EIGENVECTCRS
    2I -0.11262 -C.21982  0.96902
    4I  0.94745 -C.31764  0.03806
    2K  0.29944  C.92238  0.24405
REDUCEC MATRIX ELEMENTS IN INTERMEDIATE CCUPLING
  F2V2 -22.4570 -54.0386 -37.3505
  F4V4  -3.3899  -4.6185   3.9120
  F6V6  -3.1958   1.5941   0.8194
     G  1.C9167  C.95786  1.06842


X= 10.C, J= 13/2
EIGENVALUES
        -3C.034    7.129   53.955
EIGENVECTCRS
    2I -C.12052 -C.223C7  0.96733
    4I  0.940C3 -C.33887  0.03898
    2K  0.31911  C.914C1  0.25054
REDUCEC MATRIX ELEMENTS IN INTERMEDIATE CCUPLING
  F2V2 -23.CC29 -53.4786 -37.3646
  F4V4  -3.3879  -4.5521   3.8432
  F6V6  -3.C967   1.5432   0.7712
     G  1.C8945  C.96C5C  1.06796


X= 11.C, J= 13/2
EIGENVALUES
        -3C.672    6.427   54.795
EIGENVECTCRS
    2I -C.13651 -C.22788  0.96408
    4I  0.92359 -C.38123  0.C4067
    2K  0.35827  C.89596  0.26252
REDUCEC MATRIX ELEMENTS IN INTERMEDIATE COUPLING
  F2V2 -24.1958 -52.2548 -37.3955
  F4V4  -3.3821  -4.4286   3.7139
  F6V6  -2.8792   1.4144   0.6824
     G  1.C8474  C.96613  1.06708
```

```
X=  7.C, J= 15/2
EIGENVALUES
        -14.71C   23.318   49.948   56.053
EIGENVECTCRS
    4I  C.93721 -C.32385 -0.12943  0.C000C
    2K  0.23953  C.76235  C.55091  0.C000C
 15 2L -0.C7973 -C.56C25  0.82448  0.C000C
 17 2L  0.CCCCC  C.CCCCC  C.CCC0C  1.C000C
REDUCED MATRIX ELEMENTS IN INTERMEDIATE CCUPLING
  F2V2  -9.4857 -25.9028 -31.2421 -19.6078
  F4V4  -2.6786  -1.1279  -3.4541  -3.5651
  F6V6 -25.4831  -7.1869  15.1188   1.6876
     G  1.18298  1.C4126  0.9836C  1.C590C


X=  7.5, J= 15/2
EIGENVALUES
        -14.057   23.3C8   50.805   56.553
EIGENVECTCRS
    4I  C.9261C -C.34717 -0.14767  0.C000C
    2K  C.36539  C.72785  C.5803C  0.C000C
 15 2L -0.C9398 -C.59136  0.8C091  0.C000C
 17 2L  0.CCCCC  C.CCCCC  0.CCC0C  1.C000C
REDUCED MATRIX ELEMENTS IN INTERMEDIATE CCUPLING
  F2V2  -9.8297 -26.2427 -3C.5582 -19.6078
  F4V4  -2.667C  -C.9924  -3.6011  -3.5651
  F6V6 -24.9761  -7.4241  14.849C   1.6876
     G  1.17991  1.C3885  C.98908  1.0590C


X=  8.C, J= 15/2
EIGENVALUES
        -13.49C   23.282   51.755   57.053
EIGENVECTCRS
    4I  0.91395 -C.37C26 -C.16618  C.C000C
    2K  0.39C8C  C.69241  C.6C652  C.C000C
 15 2L -C.1095C -C.61926  0.77752  0.C000C
 17 2L  C.CCCCC  C.CCCCC  0.CC00C  1.C000C
REDUCED MATRIX ELEMENTS IN INTERMEDIATE CCUPLING
  F2V2 -1C.2101 -26.529C -29.8915 -19.6078
  F4V4  -2.65C8  -C.88C5  -3.7292  -3.5651
  F6V6 -24.4355  -7.6127  14.4970   1.6876
     G  1.17653  1.C3682  0.99449  1.C590C
```

TABLE I CONTINUED

```
X=  8.5, J= 15/2
EIGENVALUES
        -12.982   23.248   52.791   57.553
EIGENVECTCRS
    4I  0.90075 -C.393C7 -0.18478  0.0000C
    2K  0.41560  C.65635  0.62969  0.0000C
 15 2L -0.12622 -C.64398  0.75456  0.0000C
 17 2L  C.CCCCC  C.CCCCC  0.0000C  1.0000C
REDUCED MATRIX ELEMENTS IN INTERMEDIATE CCUPLING
  F2V2 -1C.6269 -26.7559 -29.2478 -19.6078
  F4V4  -2.6294  -C.792C  -3.8392  -3.5651
  F6V6 -23.8641  -7.7638  14.C767   1.6876
     G  1.17285  1.C3522  0.99977  1.C5900
```

```
X=  9.C, J= 15/2
EIGENVALUES
        -12.564   23.213   53.908   58.053
EIGENVECTCRS
    4I  0.88656 -C.41554 -0.2033C  0.0000C
    2K  0.43962  C.6199C  0.64999  0.0000C
 15 2L -C.144C6 -C.66562  C.73225  0.0000C
 17 2L  0.CCCCC  C.CCCCC  C.0CCCC  1.0000C
REDUCED MATRIX ELEMENTS IN INTERMEDIATE CCUPLING
  F2V2 -11.C797 -26.92C2 -28.63C7 -19.6078
  F4V4  -2.6025  -0.7259  -3.9321  -3.5651
  F6V6 -23.2654  -7.8872  13.6013   1.6876
     G  1.16886  1.C34C9  1.0C489  1.0590C
```

```
X=  9.5, J= 15/2
EIGENVALUES
        -12.227   23.185   55.098   58.553
EIGENVECTCRS
    4I  0.87143  C.43761 -0.22162  0.0000C
    2K  C.4627C -C.58324  0.66764  0.0000C
 15 2L -C.1629C  C.68434  0.71074  0.0000C
 17 2L  C.CCCCC  C.CCCCC  0.CCCCC  1.C000C
REDUCED MATRIX ELEMENTS IN INTERMEDIATE CCUPLING
  F2V2 -11.567C -27.C216 -28.C421 -19.6078
  F4V4  -2.5698  -G.681G  -4.C097  -3.5651
  F6V6 -22.6432  -7.991C  13.C831   1.6876
     G  1.16459  1.C3343  1.00983  1.C590C
```

```
X= 10.0, J= 15/2
EIGENVALUES
        -11.97C   23.169   56.358   59.053
EIGENVECTCRS
    4I  0.85543  C.45916 -0.23962  0.C000C
    2K  C.48468 -C.54657  0.68289  0.C000C
 15 2L -C.18258  C.7CC3I  0.69011  0.C000C
 17 2L  0.COCCC  C.CCCCC  0.CCOOC  1.C000C
REDUCED MATRIX ELEMENTS IN INTERMEDIATE CCUPLING
  F2V2 -12.C864 -27.C616 -27.4826 -19.6078
  F4V4  -2.5312  -C.6558  -4.C736  -3.5651
  F6V6 -22.C022  -8.0816  12.5327   1.6876
     G  1.16005  1.C3323  1.01456  1.C590C
```

```
X= 11.C, J= 15/2
EIGENVALUES
        -11.699   23.156   59.06C   6C.053
EIGENVECTCRS
    4I  0.82125  C.50C28 -0.27438  0.C000C
    2K  C.52488 -C.47377  0.7C715  0.C000C
 15 2L -C.22376  C.72476  0.65166  0.C000C
 17 2L  0.COOCC  C.COGCC  G.CCOOC  1.C000C
REDUCED MATRIX ELEMENTS IN INTERMEDIATE CCUPLING
  F2V2 -13.2C79 -26.9734 -26.4493 -19.6078
  F4V4  -2.4367  -C.6571  -4.1668  -3.5651
  F6V6 -2C.6836  -8.2385  11.3708   1.6876
     G  1.15031  1.G3412  1.02341  1.C590C
```

TABLE I CONTINUED

J	k	d^2	1000 f	|M| 1/2	3/2	5/2	7/2	9/2	11/2	13/2	15/2	17/2	19/2	21/2
3/2	2	4.5	223.606 798	-1	1									
5/2	2	4.3.5.7	48.795 005	-4	-1	5								
	4	36.7	62.994 079	2	-3	1								
7/2	2	4.2.3.5.7	34.503 279	-5	-3	1	7							
	4	36.2.7.11	13.430 383	9	-3	-13	7							
	6	4.2.3.11.13	17.069 718	-5	9	-5	1							
9/2	2	4.3.5.11	38.924 947	-4	-3	-1	2	6						
	4	36.5.11.13	6.232 980	18	3	-17	-22	18						
	6	4.3.5.11.13	10.795 838	-8	6	10	-11	3						
11/2	2	4.3.5.7.11.13	4.080 444	-35	-29	-17	1	25	55					
	4	36.2.7.11.13	3.724 918	28	12	-13	-33	-27	33					
	6	4.2.3.11.13.17	4.140 015	-20	4	25	11	-31	11					
13/2	2	4.2.5.7.13	16.574 839	-8	-7	-5	-2	2	7	13				
	4	36.2.7.11.13.17	0.903 425	108	63	-13	-92	-132	-77	143				
	6	4.5.7.11.13.17.19	0.393 248	-200	-25	185	227	-11	-319	143				
15/2	2	16.3.5.7.17	5.917 263	-21	-19	-15	-9	-1	9	21	35			
	4	144.7.13.17.19	0.486 068	189	129	23	-101	-201	-221	-91	273			
	6	16.3.5.13.17.19	0.996 142	-75	-25	45	87	59	-39	-117	65			
17/2	2	36.2.5.17.19	2.932 564	-40	-37	-31	-22	-10	5	23	44	68		
	4	36.2.11.17.19	1.977 134	44	33	13	-12	-36	-51	-47	-12	68		
	6	36.11.13.17.19.23	0.161 702	-440	-209	145	439	481	169	-377	-650	442		
19/2	2	4.3.5.7.11.19	3.375 221	-33	-31	-27	-21	-13	-3	9	23	39	57	
	4	36.2.5.7.11.17.19.23	0.069 848	1188	948	503	-77	-687	-1187	-1402	-1122	-102	1938	
	6	100.2.3.11.13.17.19.23	0.039 609	-1716	-988	195	1353	1931	1497	6	-1870	-2346	1938	
21/2	2	4.5.7.11.23	5.313 439	-20	-19	-17	-14	-10	-5	1	8	16	25	35
	4	36.5.7.11.13.19.23	0.112 695	702	585	365	70	-258	-563	-775	-810	-570	57	1197
	6	4.3.5.11.13.17.19.23	0.125 254	-520	-338	-30	303	537	558	306	-170	-646	-646	646

(a) S_K^0

J	7/2,-5/2	9/2,-3/2	11/2,-1/2	13/2, 1/2	15/2, 3/2	17/2, 5/2	19/2, 7/2	21/2, 9/2
7/2	0.755 929							
9/2	1.000 000	0.654 654						
11/2	2.309 401	1.825 742	1.023 533					
13/2	22.135 944	18.956 090	13.403 980	6.904 105				
15/2	8.090 398	7.236 272	5.693 469	3.765 875	1.837 559			
17/2	46.669 049	42.878 566	35.874 782	26.739 484	16.911 535	7.946 248		
19/2	179.885 678	168.267 644	146.458 185	117.166 548	84.095 184	51.497 573	23.531 134	
21/2	54.048 920	51.202 214	45.796 652	38.384 024	29.732 138	20.752 510	12.401 997	5.546 342

(b) S_6^6

TABLE II. STEVENS COEFFICIENTS

ADDITIONAL TABLES OF S_K^q MAY BE FOUND IN REFERENCE 2.

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